CLAIMS

I claim:

1. A method of generating a shortening channel impulse response in a discrete multitone transceiver, said method comprising the steps of:

(1) determining an impulse response of a channel, said impulse response having a plurality of coefficients corresponding to a length of a symbol;

(2) rotating said impulse response coefficients to a rotation that decreases inter-symbol interference.

2. The method of claim 1 wherein step (2) comprises rotating said impulse response coefficients to a rotation in which the first L+1 coefficients of said channel impulse response is maximal, where L is a length of said cyclic prefix.

3. The method of claim 1 wherein step (2) comprises rotating said impulse response coefficients to a rotation that starts with coefficient L+1, where L is a length of said cyclic prefix.

4. The method of claim 1 wherein step (2) comprises the steps of:

(2.1) selecting a plurality of rotations of said channel impulse response including and surrounding said rotation that

starts with coefficient L+1, where L is a length of said cyclic prefix;

(2.2) calculating a value for inter-symbol interference based on each of said rotations; and

(2.3) selecting a one of said rotations of said channel impulse response that yields the lowest inter-symbol interference value.

5. The method of claim 4 wherein step (2.2) is performed in the frequency domain.

6. The method of claim 5 wherein step (2.2) comprises:

(2.2.1) generating Fourier transforms of said coefficients of said channel impulse response;

(2.2.2) calculating an average value of a transmitted discrete multitone symbol; and

(2.2.3) multiplying said Fourier transforms of said coefficients with said average.

7. The method of claim 6 wherein, in step (2.2.1), said Fourier transforms are generated by fast Fourier transform.

8. The method of claim 3 wherein step (2.2) comprises calculating

$$FINTF = \bar{C}(|h'_Y|(FV_1 \cdot W) + |h'_{Y+1}|(FV_2 \cdot W) + \ldots + |h'_{P-1}|(FV_{P-Y} \cdot W))$$

where

$\overline{C}$ = an average value of a transmitted discrete multitone symbol,

Y = an integer selected based on the number of the next to last coefficient of the set of consecutive coefficients determined in step (3.1),

P = the number of coefficients in said shortening channel impulse response, and

W= is a weighting factor vector $[w_0, w_1, w_2 \ldots, w_{P-1}]^T$.

9. The method of claim 8 wherein $w_0, w_1, \ldots, w_L = 0$ and $w_{L+1}, w_{L+2}, \ldots, w_{P-1} = 1$.

10. A method of frame alignment in a discrete multitone transceiver, said method comprising the steps of:

(1) determining an impulse response of a channel, said impulse response having a plurality of coefficients corresponding to a length of a symbol;

(2) rotating said impulse response coefficients to a rotation that decreases inter-symbol interference value; and

(3) using said rotation for frame alignment.

11. The method of claim 10 wherein step (2) comprises rotating said impulse response coefficients to a rotation in which the first L+1 coefficients of said channel impulse response is maximal, where L is a length of said cyclic prefix.

12. The method of claim 10 wherein step (2) comprises the steps of:

(2.1) selecting a plurality of rotations of said channel impulse response including and surrounding said a rotation that starts with coefficient L+1, where L is a length of said cyclic prefix;

(2.2) calculating a value for inter-symbol interference based on each of said rotations; and

(2.3) selecting a one of said rotations of said channel impulse response that yields the lowest inter-symbol interference value.

13. The method of claim 11 wherein step (2.2) comprises calculating

$$FINTF = \overline{C}(|h'_Y|(FV_1 \cdot W) + |h'_{Y+1}|(FV_2 \cdot W) + \ldots + |h'_{P-1}|(FV_{P-Y} \cdot W))$$

where

$\overline{C}$ = an average value of a transmitted discrete multitone symbol,

Y = an integer selected based on the number of the next to last coefficient of the set of consecutive coefficients determined in step (3.1),

P = the number of coefficients in said shortening channel impulse response, and

W= is a weighting factor vector $[w_0, w_1, w_2, \ldots, w_{P-1}]^T$.

14. A discrete multitone transceiver comprising:

a transmitter;

a receiver;

a digital processing device adapted to generating a shortening channel impulse response by;

determining an impulse response of a channel, said impulse response having a plurality of coefficients corresponding to a length of a symbol; and

rotating said impulse response coefficients to a rotation that decreases inter-symbol interference value; and

a timing recovery circuit that aligns with a received frame using said rotation.

15. The transceiver of claim 14 wherein said digital processing device is adapted to determine said rotation by rotating said impulse response coefficients to a rotation in which the first L+1 coefficients of said channel impulse response is maximal.

16. The transceiver of claim 14 wherein said digital processing device is adapted to determine said rotation by rotating said impulse response coefficients to a rotation that

starts with coefficient L+1, where L is a length of said cyclic prefix.

17. The transceiver of claim 14 wherein said digital processing device is adapted to determine said rotation by:

selecting a plurality of rotations of said channel impulse response including and surrounding said a rotation that starts with coefficient L+1, where L is a length of said cyclic prefix;

calculating a value for inter-symbol interference based on each of said rotations; and

selecting a one of said rotations of said channel impulse response that yields the lowest inter-symbol interference value.

18. The transceiver of claim 17 wherein said digital processing device performs said calculation by:

generating Fourier transforms of said coefficients of said shortening channel impulse response;

calculating an average value of a transmitted discrete multitone symbol; and

multiplying said Fourier transforms of said coefficients with said average.

19. The transceiver of claim 17 wherein said processor calculates said inter-symbol interference, FINTF, by;

$$FINTF = \overline{C}(|h'_Y|(FV_1 \cdot W) + |h'_{Y+1}|(FV_2 \cdot W) + \ldots + |h'_{P-1}|(FV_{P-Y} \cdot W))$$

where

C = an average value of a transmitted discrete multitone symbol,

Y = an integer selected based on the number of the next to last coefficient of the set of consecutive coefficients determined in step (3.1),

P = the number of coefficients in said shortening channel impulse response, and

W= is a weighting factor vector $[w_0, w_1, w_2, \ldots, w_{P-1}]^T$.

20. A method of frame alignment in a discrete multitone transceiver, said method comprising the steps of:

(1) determining an impulse response of a channel, said impulse response having a plurality of coefficients corresponding to a length of a symbol;

(2) determining a set of consecutive samples of said channel impulse response of length L+1, where L is a length of said cyclic prefix, for which the channel impulse response energy is maximal;

(3) selecting a plurality of rotations of said shortening channel impulse response including and surrounding a rotation

that starts with a first coefficient of said consecutive samples determined in step (3);

(4) calculating a value for inter-symbol interference based on each of said rotations; and

(5) selecting a one of said rotations selected is step (3) that decreases inter-symbol interference value.

21. The method of claim 20 wherein step (4) comprises:

(4.1) generating fast Fourier transforms of said coefficients of said channel impulse response;

(4.2) calculating an average value of a transmitted discrete multitone symbol; and

(4.3) multiplying said Fourier transforms of said coefficients with said average.

22. The method of claim 20 wherein step (5) comprises calculating

$$FINTF = \overline{C}(|h'_Y|(FV_1 \cdot W) + |h'_{Y+1}|(FV_2 \cdot W) + \ldots + |h'_{P-1}|(FV_{P-Y} \cdot W))$$

where

C = an average value of a transmitted discrete multitone symbol,

Y = an integer selected based on the number of the next to last coefficient of the set of consecutive coefficients determined in step (3.1),

P = the number of coefficients in said shortening channel impulse response, and

W= is a weighting factor vector $[w_0, w_1, w_2, \ldots, w_{P-1}]^T$.